ATMOSPHERIC ELECTRICITY.

GENERAL STATISTICS.

The table showing in detail for October, 1894, the statistics relative to auroras and thunderstorms is placed among the meteorological tables as No. XI, instead of being given in the text as heretofore. It shows the number of stations from which meteorological reports were received, and the number of such stations reporting thunderstorms (T) and auroras (A) in each State and on each day of the month.

THUNDERSTORMS.

A mention of the more severe thunderstorms reported during the month is given under "Local storms." The dates on which reports of thunderstorms were most numerous were: 3d, 50; 13th, 48; 20th, 83; 21st, 61; 25th, 68.

The States where thunderstorm reports were most numerous were: Missouri, Minnesota, Ohio, Wisconsin, Oregon, Illinois, and Iowa.

The States where the dates of thunderstorms were most frequent were: Missouri, where they were recorded on eighteen days; Ohio, seventeen days; Minnesota and Wisconsin, fourteen days.

DAMAGE BY LIGHTNING.

The following statistics of the damage done by lightning in October, so far as reported by the observers of this Bureau, are furnished by Mr. Alexander McAdie:

During October, 1894, 7 persons were killed and 2 severely injured; 2 barns, 2 dwellings, 3 churches, and 2 car stables burned.

AURORAS.

The evenings on which bright moonlight must have interfered with observations of faint auroras are assumed to be the four days preceding and following the date of full moon, viz, from the 10th to the 18th, inclusive. On the remaining twenty-two days of this month 103 reports were received, or an average of 5 per day. The dates on which the reported number especially exceeded this average were: 25th, 21; 27th, 11; 29th, 8. The States from which auroras were reported by a large percentage of observers were: North Dakota and Delaware.

The States where the dates of auroras were most frequent were: North Dakota, 16; Minnesota, 11.

CANADIAN DATA—THUNDERSTORMS AND AURORAS.

Thunderstorms were reported as follows: 3d, Toronto, Ont. 4th and 5th, Port Stanley, Ont. 17th, Grindstone, Gulf of St. L., Charlottetown, P. E. I., and Grand Manan, N. B. 20th, Port Stanley, Ont. 23d, Quebec, Que.

Auroras were reported as follows: 2d, Quebec, Que., and St. Andrews, N. B. 5th, St. Andrews, N. B. 17th, Port Arthur, Ont. 20th and 22d, Father Point, Que. 29th, Quebec and Father Point, Que. 30th, Grindstone, Gulf of St. L., Father Point, Que., St. Andrews, N. B., and Charlottetown, P. E. I.

METEOROLOGY AND MAGNETISM.

The movements of our atmosphere are to be studied primarily as problems in the mechanics and thermodynamics of moving gases and vapors, but our knowledge of the empirical relations between atmospheric phenomena and those of terrestrial magnetism has been elucidated by a few special students, and further study in this direction has been recognized by the Chief of the Weather Bureau as proper and desirable. In accordance with the views that have been frequently explained by Professor Bigelow as to the action of the sun upon the earth there are two classes of influence that emanate from the sun, i. e., (1) a direct flow of energy that is known to us as sunshine and radiant energy; (2) an indirect flow that proceeds from the sun in curved lines which are called coronal beams when seen during a solar eclipse, or auroral beams when seen during an aurora, or magnetic curves when revealed by the disturbances of the magnetic needle. The coronal curves are normals to the so-called equipotential surfaces, and have the same form whether the phenomenon is one of fluid motion or of electric influence. In order to avoid any appearance of undue partiality to any theory, Professor Bigelow calls these lines the coronal field, because they were first studied in the photographs of solar eclipses. Those studies showed that the coronal field is as permanently attached to the sun as our own magnetic system is attached to the earth. The solar coronal poles and equator are analogous to the earth's magnetic poles and magnetic equator. Any influence that passes from the sun to the earth in straight lines through the mediation of the ether of space is considered to belong to the radiant field. Any other influence that proceeds along the coronal lines belongs to the coronal field, and if it reaches the earth and affects our atmosphere it is said to be superposed upon the radiant field. According to Professor Bigelow the solar corona and the coronal field revolve about the sun's axis and the synodic revolution is completed in 26.68 mean solar days; he finds the same period in terrestrial magnetic phenomena, so that a cycle of magnetic changes completes itself in this interval. It matters not whether these magnetic conditions and disturbances are caused by the changes produced in the earth's atmosphere by the sun and moon, or whether the sun and moon have a direct influence on the magnetic condition, it suffices for the present to recognize that the phenomena are sensibly synchronous with each other, and that the study of both together promises to elucidate laws that have hitherto been obscure. According to the remarkable memoir by Balfour Stewart (see Encyclopædia Britannica, article Meteorology, p. 184) "it would seem that terrestrial meteorology and terrestrial magnetism are probably cognate subjects, and that they ought to be studied together in the well-founded hope that the phenomena of the one will help us to explain those of the other."

As the subject of atmospheric electricity, including that of auroras and earth currents, has a small section in this REVIEW, the Editor takes pleasure in introducing a new section on terrestrial magnetism. The following text, together with Chart VI, will present from month to month a small part of the work being done by the Weather Bureau in this direction.

THE COMPARISON OF TEMPERATURE WITH MAGNETIC HORIZONTAL FORCE.

By Prof. F. H. BIGELOW.

In response to the request of the Chief of the Weather Bureau, the directors of the observatories at Toronto, Washington, and San Antonio have courteously undertaken to forward to the Bureau, as promptly as possible, certain data from their magnetograms, namely, the mean ordinates for the day from twenty-four hourly readings of the horizontal force, the declination, and the vertical force, uncorrected for instrumental errors and changes of temperature. On days exhibiting very disturbed magnetic conditions the hours and the values of the maximum and minimum ordinates are given.

The object in collecting these data is to institute a comparison between the crude magnetic readings, particularly of the bifilar, and the temperature changes at meteorological stations in the northwest. Ultimately such comparisons will show how far unreduced magnetic observations may be available for determining the direction and the intensity of the temperature variations and other weather conditions before these become fully developed, as given by the isotherms and isobars of the daily weather maps. It has already been shown that weather and magnetism conform on the average to a normal type, but the problem of the synchronous changes from day to day is still under advisement as a practical feature in forecasting. The original data are presented on Chart VI in a slightly reduced form, without further comment, thus offering the reader an opportunity for individual study.

The columns headed Calgary, Williston, and Sioux City, give for each day, respectively, the mean of the 8 a. m. and 8 p. m. observations of temperature at the following groups of stations:

Calgary for Minnedosa, Qu'Appelle, Prince Albert, Swift Current, Medicine Hat, Battleford, Edmonton, Calgary.

Williston for Valentine, Yankton, Huron, Pierre, Moorhead, Bismarck, Williston.

Sioux City for Springfield, Mo., Kansas City, Wichita, Concordia, Omaha, Sioux City.

The average temperature for each group is reduced back to the origin, W. 115°, N. 55°, by a correction for eastward drift (see Amer. Jour. Sci., Dec., 1894). The first differences of these numbers are taken; then the monthly mean of the first differences for slope; then the variations on the slope; then these latter are added successively throughout the month and the accumulated sums give the ordinates of the curve for each group; the mean of these three groups is taken and gives the curve in the upper part of Chart VI; the monthly mean of the ordinates being —5, this is added with reverse sign to reduce to a true datum line. Thus, the eastward drift and the slope have been eliminated, and the variations reduced to a zero base line. The final temperature variations are multiplied by —2, the minus sign being required for an inversion which seems to have prevailed during October.

The magnetic data are treated in the same way as the temperatures, excepting that in order to reduce to a similar amplitude the readings of horizontal magnetic force at San Antonio are divided by 3. The curve as plotted is the mean of the ordinates of the three stations.

It has been found that at least five magnetic observations are required to eliminate local conditions and to give a true value of the external impressed field, though seven are better. By inspecting the columns it will be seen that local variations disturb the curves in certain cases. Hence, as the data now exists, the comparison can give only partially accurate curves as to detail, though the main features may be expected to appear. No important magnetic disturbances were reported for October. The dates of beginning of the 26.68 day period are October 1.22 and October 27.90. These curves should be compared with the inverse type, and this has been effected by applying the factor —2 to the temperature data as above stated.

INLAND NAVIGATION.

STAGE OF WATER IN RIVERS.

The following table shows the danger point and the highest and lowest stages for the month of October, 1894:

Heights of rivers above low-water mark, October, 1894.

Stations.	Danger-point on gauge.	Highest water.		Lowest water.		Monthly range.
		Height.	Date.	Height.	Date.	
Red River.	*Feet.*	*Feet.*		*Feet.*		*Feet.*
Shreveport, La	29.2	— 2.3	14	— 4.9	31	2.6
Arkansas River.						
Fort Smith, Ark	22.0	3.4	2, 3	1.0	31	2.4
Little Rock, Ark	23.0	5.0	1	2.9	31	2.1
Missouri River.						
Bismarck, N. Dak	75.0	3.2	11, 12	2.8	8, 30, 31	0.4
Pierre, S. Dak	13.0	2.3	22, 24, 25	1.8	6–13	0.5
Sioux City, Iowa	18.7	6.7	2	5.7	18, 19	1.0
Omaha, Nebr	18.0	.....	.....	.....	.....	.....
Kansas City, Mo	21.0	7.9	19	6.3	25, 26	1.6
Mississippi River.						
St. Paul, Minn	14.0	2.2	12	1.6	18, 19, 27, 28	0.6
La Crosse, Wis	10.0	1.9	31	1.2	1	0.7
Dubuque, Iowa	16.0	1.7	31	0.9	1–4	0.8
Davenport, Iowa	15.0	1.0	29–31	0.6	2–21	0.4
Keokuk, Iowa	14.0	0.7	30, 31	— 0.2	8, 10, 13	0.9
Hannibal, Mo	17.0	1.2	31	0.5	8, 9, 11, 20	0.7
St. Louis, Mo	30.0	4.0	1	2.4	23, 24, 29, 30	1.6
Cairo, Ill	40.0	6.4	5, 6	2.9	31	3.5
Memphis, Tenn	33.0	1.4	8, 9	— 1.1	30, 31	2.5
Vicksburg, Miss	41.0	1.2	1	— 4.2	30, 31	5.4
New Orleans, La	13.0	6.6	8	2.8	14, 28, 30, 31	3.8
Ohio River.						
Parkersburg, W. Va	38.0	3.5	1	0.7	29, 30	2.8
Cincinnati, Ohio	45.0	9.0	1	3.5	24	5.5
Louisville, Ky	24.0	6.3	1	2.4	25–27	3.9
Cumberland River.						
Nashville, Tenn	40.0	0.5	1, 2	— 0.3	24–31	0.8
Tennessee River.						
Chattanooga, Tenn	33.0	2.4	15	0.7	27–29	1.7
Knoxville, Tenn	29.0	.....	.....	.....	.....	.....
Monongahela River.						
Pittsburg, Pa	22.0	6.4	18	5.0	4, 10, 26	1.4

Heights of rivers—Continued.

Stations.	Danger-point on gauge.	Highest water.		Lowest water.		Monthly range.
		Height.	Date.	Height.	Date.	
Savannah River.	*Feet.*	*Feet.*		*Feet.*		*Feet.*
Augusta, Ga	32.6	27.6	10	5.4	31	22.2
Willamette River.						
Portland, Oregon	15.0	5.4	28	1.7	9	3.7
Susquehanna River.						
Harrisburg, Pa	17.0	.....	.....	.....	.....	.....
Alabama River.						
Montgomery, Ala	48.0	1.8	11	—0.5	27–31	2.3
James River.						
Lynchburg, Va	18.0	2.2	1	0.0	26–30	2.2
Sacramento River.						
Red Bluff, Cal	22.0	8.5	24	0.7	3–17	7.8
Sacramento, Cal	25.0	11.7	25, 26	7.5	10, 11	4.2
Des Moines River.						
Des Moines, Iowa*	19.0	3.3	7–10, 28	3.0	1–4	0.3

* Record for 20 days.

The above table shows that no floods occurred during the month in the rivers therein tabulated. In most cases the rivers were unusually low.

FLOODS AND NAVIGATION.

The reports of floods were confined to a few rivers in the south Atlantic coast region. On the 9th the Congaree River at Columbia, S. C., rose 4.7 feet above the danger line, flooding the lowlands. As a rule, the rivers in the interior of the country reached extreme low water during this month and, in some cases, were lower than at any time during the past fifty years.